
NASA-05700 (June 2004)
NATIONAL AERONAUTICS NASA
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(September 2002)

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SECTION 05700

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06/04

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SECTION 05700

ORNAMENTAL METAL
06/04

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers ornamental metal products used in building construction for functional, architectural, and decorative effects including the following:

Utilitarian miscellaneous metals products, such as floor grating and frames, floor plate covers and frames, steel pipe railings and steel stairs, are specified in Section 05500, "Metal Fabrications" and Section 05510, "Metal Stairs."

Cabinet hardware for wood cabinets and aluminum trim for chalkboards and tackboards are specified in Section 06200, "Finish Carpentry."

Sheet metal work except that which is a part of extruded aluminum gravel stop system (including nonferrous metal flashing, aluminum sheet metal louvers, and nonferrous metal gutters and downspouts), metal roofing and siding (including aluminum roofing and siding and porcelain enameled sheets), and aluminum gravity roof ventilators are specified in Division 7, "Thermal and Moisture Protection."

Aluminum doors and frames, aluminum shapes for sound-retardant door perimeter seals and door bottoms, aluminum windows, aluminum curtain wall systems, and finish hardware are specified in Division 8, "Doors and Windows."

Aluminum grids for lay-in acoustical panels, metal divider strips for terrazzo work, and metal trim for resilient flooring and vinyl wall coverings are specified in Division 9, "Finishes."

Metal partitions (including finish hardware) and metal toilet accessories are specified in Division 10, "Specialties."

Elevated floor system extruded aluminum grilles and registers, die cast aluminum panels and other aluminum components are specified in Section 10275, "Elevated Floor System."

Prefabricated metal buildings, aluminum siding, aluminum windows, aluminum ventilators, and other aluminum components are specified in Section 13121, "Pre-Engineered Buildings."

Thresholds for elevator hoistway entrances are specified in Division 14, "Conveying Systems."

Aluminum grilles, registers and louvers for heating, ventilating and air conditioning systems are specified in Division 15, "Mechanical."

Drawings must include a complete design indicating the character of the work to be performed and giving the following:

Location and details of each metal item, indicating dimensions, shapes and sizes of members, connections, and the relation to other building components.

Anchorage devices embedded in other construction.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45 (2003) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.13 (1997) Screw and Washer Assemblies

ANSI B18.13.1M (1991; R 1998) Screw and Washer Assemblies (Metric Series)

ANSI B18.21.1 (2000) Lock Washers (Inch Series)

ANSI B18.21.2M (2000) Lock Washers (Metric Series)

ANSI B18.22.1	(1975; R 1998) Plain Washers
ANSI B18.22M	(1981; R 2000) Metric Plain Washers

AMERICAN WELDING SOCIETY (AWS)

AWS A5.3/A5.3M	(1999) Specification for Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
AWS D1.2	(2003) Structural Welding Code Aluminum

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws, Including Hex Cap and Lag Screws (Inch Series)
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts
ASME B18.2.3.8M	(1981; R 1999) Metric Hex Lag Screws
ASME B18.2.4.1M	(2002) Metric Hex Nuts, Style 1
ASME B18.3.3M	(1986; R 1993) Hexagon Socket Head Shoulder Screws (Metric Series)
ASME B18.6.1	(1981; R 1997) Wood Screws (Inch Series)
ASME B18.6.3	(1998) Machine Screws and Machine Screw Nuts
ASME B18.6.7M	(2000) Metric Machine Screws

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2004) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(2003) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 283/A 283M	(2003) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 47/A 47M	(1999) Standard Specification for Ferritic Malleable Iron Castings
ASTM B 209/B 209M	(2004) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 211	(2003) Standard Specification for Aluminum

	and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(2003) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 221/B 221M	(2003) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 247	(2002a) Standard Specification for Aluminum and Aluminum-Alloy Die and Hand Forgings and Rolled Ring Forgings
ASTM B 247M	(2002a) Standard Specification for Aluminum and Aluminum-Alloy Die and Hand Forgings and Rolled Ring Forgings (Metric)
ASTM B 26/B 26M	(2003) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 316/B 316M	(2002) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold Heading Wire and Rods
ASTM B 429	(2002) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 514	(2001) Standard Specification for Nails for the Application of Gypsum Board
ASTM C 636	(2003) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM D 1730	(2003) Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
ASTM D 1752	(2004) Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM G 104	(1989) Standard Test Method for Assessing Galvanic Corrosion Caused by the Atmosphere

INDUSTRIAL FASTENERS INSTITUTE (IFI)

IFI 502	(1982) Metric Tapping Screws
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-01	(1993; 3rd Ed) Good Painting Practice Steel Structures Painting Manual, Volume 1
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-344

(Rev A) Lacquer (Clear Gloss)

FS RR-W-360

(Rev A) Wire Fabric, Industrial

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330, "Submittal Procedures," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Survey data showing Existing Conditions shall be submitted prior to work in accordance with paragraph entitled, "Field Measurements," of this section.

SD-02 Shop Drawings

Fabrication drawings shall be submitted for Ornamental Metal Items in accordance with the paragraph entitled, "Fabrication in General," of this section.

Installation Drawings shall be submitted for the following items in accordance with paragraph entitled, "Fabrication In General," of this section.

Ornamental Metal Items
Shop and Field Connections
Construction Details

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items listing all ornamental metal accessories including casting, forgings, fasteners and anchorage devices.

Installation Materials
Metals for Fabrication
Ornamental Metal Items

SD-04 Samples

Manufacturer's Standard Color Charts for the following items shall be approved by the Contracting Officer prior to work.

Shop Paint

Finish Paint

Samples for Aluminum Finishes, one for each type, shall be in accordance with paragraph entitled, "Aluminum Finishes," of this section.

Samples for each type of Anchorage Devices and Fasteners shall be in accordance with paragraph entitled, "Installation Materials," of this section.

Samples for each type of Architectural Metal Items shall be in accordance with paragraph entitled, "Metals for Fabrications," of this section.

Samples for aluminum finishes, two of each type, shall be in accordance with paragraph entitled, "Ornamental Metal Items," of this section.

Samples shall be standard size as used in construction. After approval, full-sized samples may be used in construction, provided each sample is clearly identified and its location recorded.

SD-06 Test Reports

Test reports for Welding Tests shall be in accordance with AWS D1.2, "Qualifications of Procedures and Personnel."

SD-07 Certificates

Welding Procedures shall be in accordance with AWS D1.2, "Structural Welding Code - Aluminum."

Certificates for Ornamental Metal Items shall be submitted in accordance with the paragraphs entitled, "Metals For Fabrication" and "Ornamental Metal Items." Certificates of Welder Qualifications shall be in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

SD-08 Manufacturer's Instructions

Preventative Maintenance and Inspection for the following items shall be in accordance with paragraph entitled, "Aluminum Finishes," of this section.

Cleaning Materials
Application Methods

1.3 QUALIFICATIONS FOR WELDING WORK

NOTE: If Section 05096, "Welding Aluminum Construction," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

[Section 05096, "Welding Aluminum Construction," applies to work specified in this section.]

[Welding Procedures and Welding Tests shall be in accordance with AWS D1.2. Test specimens shall be made in the presence of Contracting Officer and tested by an approved testing laboratory at the Contractor's expense.

Certification of Welder Qualifications by tests in accordance with AWS D1.2.

In addition, tests shall be performed on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, an immediate retest of two test welds shall be made. Failure in either of the two immediate retests shall require the welder be retested after further practice or training, and a complete set of test welds shall be made.]

1.4 DELIVERY, STORAGE, AND HANDLING

Architectural metal items shall be stored off the ground.

Materials shall be kept free from dirt and grease and shall be protected from corrosion.

Packaged materials shall be stored in their original, unbroken containers in a dry area, until ready for installation.

1.5 FIELD MEASUREMENTS

Records of Existing Conditions shall be provided by the Contracting Officer prior to the start of work. Field measurements shall be taken prior to preparation of shop drawings and fabrication.

PART 2 PRODUCTS

2.1 INSTALLATION MATERIALS

2.1.1 Concrete Inserts

NOTE: Concrete inserts must be used for fastening ornamental metal items to cast-in-place concrete construction when the anchorage device will be subjected to direct pull-out loadings such as fascia flanges for ornamental or pipe railings.

Wedge-type concrete inserts shall be galvanized, box-type, ferrous castings with integral anchor loop at back of box and be designed to accept bolts having special wedge shape heads. Ferrous castings shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510 or Grade 35018, [Grade 22010 or Grade 24118,] or may be medium-strength cast steel conforming to ASTM A 27/A 27M, Grade U-60-30. Inserts shall be hot-dip galvanized after fabrication in accordance with ASTM A 153/A 153M. Carbon steel bolts shall be provided with special wedge shape heads, nuts, washers, and shims. Such hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

Slotted-type concrete inserts shall be hot-dip galvanized, pressed steel plate, welded construction, box-type, with slot to receive square head bolt and to provide lateral adjustment of the bolt. Length of insert body less anchorage lugs shall be not less than 4-1/2 inches 115 millimeter. Inserts shall be provided with knockout cover. Steel plate shall be not less than 1/8 inch 3 millimeter thick and shall conform to ASTM A 283/A 283M, Grade

C. Inserts shall be hot-dip galvanized after fabrication in accordance with ASTM A 123/A 123M.

Concrete inserts shall not be removable when embedded in concrete of 3,000 pounds per square inch 20 Megapascal compressive strength and subjected to a 6,000-pound 26.7 kilonewton tension load test in an axial direction, nor shall the concrete indicate any evidence of failure attributable to the anchoring device itself.

2.1.2 Masonry Anchorage Devices

NOTE: Masonry anchorage devices must be used only for the fastening of ornamental metal items to solid masonry and concrete-in-place construction when the anchorage device will not be subjected to direct pull-out loadings nor to vibration. Masonry anchorage devices must be used only for non-vibratory shear loads.

Masonry anchorage devices shall be expansion shields conforming to ASTM C 514, Group, Type, and Class as follows:

Lead expansion shields for machine screws and bolts 1/4 inch 6 millimeter and smaller shall be head-out embedded nut type, single-unit class, conforming to Group I, Type 1, Class 1.

Lead expansion shields for machine screws and bolts larger than 1/4 inch 6 millimeter shall be head-out embedded nut type, multiple-unit class, conforming to Group I, Type 1, Class 2.

Bolt anchor expansion shields for lag bolts shall be zinc-Alloy long-shield anchors class, conforming to Group II, Type 1, Class 1.

Bolt anchor expansion shields for bolts shall be closed-end bottom bearing class, conforming to Group II, Type 2, Class 1.

2.1.3 Toggle Bolts

NOTE: Toggle bolts must be used for fastening ornamental metal items to hollow masonry and stud partitions.

Toggle bolts shall be tumble wing type of the class and style best suited for the work, conforming to ASTM C 636, Type II. Toggle bolts shall be made of corrosion-resistant chromium-nickel steel conforming to AISI Type 302, 303, 304, 305, or 316.

2.1.4 Standard Bolts and Nuts

Standard bolts shall be regular hexagon head, corrosion-resistant steel, coarse thread series, conforming to ASME B18.2.1 ASME B18.3.3M, Type II.

Standard nuts shall be plain hexagon, regular style, corrosion-resistant steel, conforming to ASME B18.2.2 ASME B18.2.4.1M, Type II, Style 4.

2.1.5 Lag Bolts

Lag bolts shall be square head, gimlet point or cone point, corrosion-resistant steel, conforming to ASME B18.2.1 ASME B18.2.3.8M, Type I, Grade C.

2.1.6 Machine Screws

Machine screws shall be corrosion-resistant steel, cross-recess drive, flat head, conforming to ASME B18.6.3 ASME B18.6.7M, Type III, Style 2C.

Machine screws shall be corrosion-resistant steel, drive, flat head, conforming to ASME B18.6.3 ASME B18.6.7M, Type III, Style 3C.

2.1.7 Wood Screws

Wood screws shall be corrosion-resistant steel, single-thread, flat head with cross-recess drive, conforming to ASME B18.6.1 IFI 502.

2.1.8 Plain Washers

Plain washers shall be round, general-assembly, corrosion-resistant steel, conforming to ANSI B18.22.1 ANSI B18.22M, Type A, Grade I, Class B.

2.1.9 Lock Washers

Lock washers shall be helical spring, corrosion-resistant steel (nonmagnetic), conforming to ANSI B18.13 and ANSI B18.21.1 ANSI B18.21.2M and ANSI B18.13.1M.

2.1.10 Welding Filler Metal

Welding filler metal for welding of aluminum alloys shall conform to AWS A5.3/A5.3M. Filler metal shall be the aluminum-alloy recommended by the aluminum producer for the work.

2.2 METALS FOR FABRICATION

NOTE: Delete the following metals that are not required for the items specified in paragraph "Ornamental Metal Items." The specified metals are only those which are common to several architectural metal items. Metals (and other materials) which are required only for a specific architectural metal item are specified in the paragraph for the item.

2.2.1 Aluminum-Alloy Extrusions

Extrusions shall be 6063, temper T5, conforming to ASTM B 221/B 221M.

Aluminum-alloy extrusions to receive an integral-color anodized coating shall be the aluminum alloy and temper recommended by the aluminum producer for the specified finish with integral-color anodized coating, and shall have mechanical properties equal to, or exceeding, those of aluminum alloy 6063, temper T5, conforming to ASTM B 221/B 221M.

2.2.2 Aluminum-Alloy Sheets and Plates

Aluminum-alloy sheets and plates, unless otherwise specified, shall be aluminum alloy 3003, temper H16, conforming to ASTM B 209/B 209M.

Aluminum-alloy sheets and plates to receive a clear anodized coating shall be aluminum alloy 5005, temper H16, conforming to ASTM B 209/B 209M.

Aluminum-alloy sheets and plates to receive an integral-color anodized coating shall be the aluminum alloy and temper recommended by the aluminum producer for the specified coating, and shall have mechanical properties equal to, or exceeding, those of alloy 5005, temper H16 of ASTM B 209/B 209M.

2.2.3 Aluminum-Alloy Castings

Aluminum alloy castings shall be alloy 5140, temper F, sand castings, conforming to ASTM B 26/B 26M.

Aluminum-alloy castings to receive a clear anodized coating shall be aluminum alloy as recommended by the Aluminum Association.

Aluminum-alloy castings to receive an integral-color anodized coating shall be the casting alloy and condition recommended by the aluminum producer for the specified finish with integral-color anodized coating, and shall have mechanical properties equal to, or exceeding, those of alloy 5140, temper F, conforming to ASTM B 26/B 26M.

2.2.4 Aluminum-Alloy Forgings

Aluminum-alloy forgings shall be aluminum alloy 6061, temper T6, conforming to ASTM B 247 ASTM B 247M.

Aluminum-alloy forgings to receive an integral-color anodized coating shall be the aluminum alloy and temper recommended by the aluminum producer for the specified finish with integral-color anodized coatings, and shall have mechanical properties equal to or exceeding those of aluminum alloy 6061, temper T6, conforming to ASTM B 247 ASTM B 247M.

2.2.5 Metals for Fasteners

Aluminum-alloy bolts and screws shall be made from rod conforming to ASTM B 211 ASTM B 211M, alloy 2024 and temper T351.

Aluminum-alloy nuts shall be made from rod conforming to ASTM B 211 ASTM B 211M, alloy 6061 and temper T6.

Aluminum-alloy washers shall be made from sheet conforming to ASTM B 209/B 209M, alloy 2024 and temper T4.

Aluminum-alloy rivets shall be made from rod or wire conforming to ASTM B 316/B 316M, alloy 6053 and temper T61.

Corrosion-resistant steel fasteners shall be made of chromium-nickel steel, AISI Type 302, 303, 304, 305, or 316, with form and condition best suited for the application.

2.2.6 Shop Paint for Aluminum

Shop paint shall be an inhibitive epoxy polyamide primer conforming to

SSPC-01, Chapter 16 and ASTM G 104.

2.3 ORNAMENTAL METAL ITEMS

NOTE: Additional paragraph headings and paragraphs specifying special ornamental metal items, such as aluminum window sills for other than aluminum windows, aluminum mullions that are not a part of a curtain wall system, and any other item not specified, must be added as required.

2.3.1 Aluminum Building Letters

NOTE: Details of building letters, including letter style, height, face dimension and depth, must be indicated.

Aluminum building letters shall be the style, size, and letters indicated.

Aluminum letters shall be made of aluminum-alloy castings. Letters shall be drilled and tapped to receive threaded fasteners for concealed mounting.

Finish of exposed face of letters shall be satin finish with Class 1 clear anodized coating.

Letter mountings shall be concealed projected type. Letters shall be projected 1/2 inch 13 millimeter from the backing surface with corrosion-resistant steel spacer sleeves and corrosion-resistant steel threaded studs. Studs shall be not less than 1/4 inch 6 millimeter in diameter. Holes shall be drilled in the backup material to receive studs. Studs shall be set in drilled holes with mastic cement. Letter spacing and drilled holes shall be in accordance with the aluminum letter manufacturer's letter spacing and drilling template.

2.3.2 Aluminum Joint Cover Assemblies

Aluminum joint cover assemblies shall be designed for horizontal movement and the joint width indicated.

Floor joint cover assemblies shall consist of continuous frame unit on each side of floor-to-floor joints or on one side of floor-to-wall joints as required by construction conditions. Assemblies shall include floor cover plates, filler strips, anchors, and other accessories as required to complete the installation, and as follows:

Floor frame units shall be aluminum-alloy extrusions fabricated to provide an integral curb edge bar for the expansion joint edges, integral grooves to receive anchor bolts, and floor cover plate and filler strip surfaces that will finish flush with the finished floor elevation when the floor cover assembly is installed. Corrosion-resistant coated aluminum alloy or steel anchor bolts and nuts shall be provided, spaced not more than 3 inches 75 millimeter from each end and not more than 18 inches 450 millimeter on center between end anchors. Frame splice connectors shall be provided as required to complete the installation.

Plain type floor cover plates shall be aluminum-alloy extrusions with smooth surface.

Recessed type floor cover plates shall be aluminum-alloy extrusions with recess to receive resilient floor covering. Depth of recess shall be that required to provide a resilient floor covering surface flush with the finished floor elevation.

Nonslip-type floor cover plates shall be aluminum-alloy castings with abrasive grit embedded uniformly into the walking surface at the time of casting. Abrasive grit shall be 20-grain aluminum oxide.

Floor cover plates shall be of the patterns and widths indicated. Lengths shall be as long as practical. Metal thickness shall be not less than 1/4 inch 6 millimeter. Fixed edge of floor cover plates shall be drilled and countersunk to receive flathead screws, spaced not more than 3 inches 75 millimeter from each cover plate end and not more than 18 inches 450 millimeter on center between the end screw holes. Screws for securing floor cover plates shall be made of corrosion-resistant steel.

Finish of exposed-to-view surfaces shall be mill finish.

Filler strips shall be rubber and cork composition tape with pressure-sensitive adhesive coating on one face and smooth suede surface on the exposed face, conforming to ASTM D 1752. Filler strip shall be not less than 1-1/2 inches 38 millimeter wide and depth as required to provide a surface flush with the finished floor elevation.

Wall and ceiling joint cover assemblies shall consist of continuous anchor strips on one side of the wall or ceiling expansion joint; wall and ceiling cover plates; and seals, anchors, and other accessories as required to complete the installation, and as follows:

Wall and ceiling anchor strips shall be aluminum-alloy extrusions fabricated to provide an integral curb bar edge and integral lugs to receive snap-on cover plates. Fixed edge of anchor strips shall be field drilled with holes to receive screws, spaced not more than 3 inches from each end and not more than 12 inches 300 millimeter on center between the end screw holes. Cadmium-plated screws with masonry anchorage devices or toggle bolts shall be provided as required by construction conditions.

Wall and ceiling cover plates shall be aluminum alloy extrusions of the patterns and widths indicated, designed for snap-on application over anchor strips, fabricated with integral grooves to receive sealing gaskets, and having a smooth exposed-to-view surface.

Vinyl sealing gaskets shall be provided for [exterior wall joint cover assemblies] [wall and ceiling joint cover assemblies].

Finish of exposed-to-view surfaces shall be frosted finish with Class II clear anodized coating.

Finish of interior wall and ceiling joint cover assembly exposed-to-view surfaces shall be frosted finish with lacquer coating.

Finish of exterior wall joint cover assembly exposed-to-view surfaces shall be frosted finish with Class II clear anodized coating.

2.3.3 Aluminum Ornamental Railings

NOTE: Aluminum pipe railings that are principally utilitarian in function are specified in the paragraph "Aluminum Pipe Railings." Steel pipe railings, steel stair railings, and handrails are specified in Section 05500, "Metal Fabrications." Design requirements for railings are specified in section 5-316 of the National Fire Protection Association NFPA 101, "Code for Safety to Life from Fire in Buildings and Structures" and OSHA Standard CFR 29 PART 1910.23.

Aluminum ornamental railings shall include railings at open-sided areas, consisting of horizontal rails and posts; and handrails at walls, as indicated.

Railing components shall be made of aluminum-alloy extrusions, aluminum-alloy forgings, or aluminum-alloy castings. Horizontal rails, posts, handrails, and brackets shall be the shapes and dimensions indicated.

Finish of exposed-to-view surfaces shall be [frosted finish with lacquer coating.] [frosted finish with Class II clear anodized coating.] [polished finish with Class II clear anodized coating.] [satin finish with Class II clear anodized coating.] [matte finish with Class II clear anodized coating.] [polished frosted finish with Class II clear anodized coating.] [polished frosted finish with integral color anodized coating.]

2.3.4 Aluminum Pipe Railings

NOTE: Steel pipe railings are specified in Section 05500, "Metal Fabrications." Design requirements for railings are specified in NFPA 101 and OSHA Standard CFR 29 PART 1910.23.

Aluminum pipe railings shall include railings at open-sided areas, consisting of top rail, intermediate rail, and posts; and handrails at walls, as indicated.

Railings shall be made of 1-1/2-inch 40 millimeter nominal size, Schedule 40, aluminum-alloy pipe. Pipe shall be extruded seamless structural pipe, aluminum alloy 6063, temper T6, conforming to ASTM B 429.

Joining posts, rails, and corners shall be done in one of the following ways:

Flush-type aluminum railing fittings, welded and ground smooth, with railing splice locks secured with 3/8-inch 10 millimeter hexagonal recessed-head setscrews

Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight-fitting interior sleeve not less than 6 inches 150 millimeter long.

Railings may be bent at corners instead of joining, provided the bends are made in suitable jigs and that the cylindrical cross-section of the pipe is maintained throughout the entire bend.

Joining of posts, rails, and corners shall be done with lockscrew type aluminum rail fittings.

Prior to securing in place, railings shall be adjusted to ensure proper matching at abutting joints and correct alignment throughout their length.

Removable railing sections shall be provided as indicated.

Kickplates shall be provided between railing posts where indicated. Kickplates shall be aluminum alloy flat bars 3/16-inch 5 millimeter thick by not less than 6-inches 150 millimeter high. Kickplates shall be secured as indicated.

[Finish of [exterior] [interior] aluminum railing exposed-to-view surfaces shall be frosted finish with Class [I] [II] clear anodized coating.]

[Finish of exposed-to-view surfaces shall be frosted finish with Class I clear anodized coating.]

2.3.5 Exterior Architectural Louvers

**NOTE: Louvers formed of sheet metal are specified
in Section 07600, "Flashing and Sheet Metal."**

Exterior architectural louvers shall be stationary type, 4-inches 100 millimeter thick, and in the sizes indicated.

[Aluminum louvers shall be made of aluminum-alloy extrusions having a wall thickness not less than 0.080 inch 2.0 millimeter.]

[Aluminum louvers shall be made of aluminum-alloy extrusions having a wall thickness not less than 0.125 inch 3.2 millimeter.]

**NOTE: The free area of louvers having water baffle
type blades is about 30 percent for louvers 12
inches 300 millimeter in height, and about 60
percent for louvers 54 to 96 inches 1350 to 2450
millimeter in height.**

**The free area of louvers having 45-degree, Z-shaped
blades is about 35 percent for louvers 12 inches 300
millimeter in height and about 65 percent for
louvers 48 inches 1200 millimeter in height.**

**The free area of louvers having 30-degree, Z-shaped
blades is about 30 percent for louvers 12 inches 300
millimeter in height and about 50 percent for
louvers 42 to 96 inches 1050 to 2450 millimeter in
height.**

It is recommended that the air velocity through the

free opening in feet per minute meter per second and
the air flow system friction loss in inches of
water gage pascal be investigated prior to selecting
each louver size.

Blades shall have a slope of [30] [45] degrees, [water baffle at center,
and return bend at the upper edge.] [be Z-shaped with stiffener ribs at the
third points, and have a return bend at the upper edge.] [be Z-shaped, and
have a return bend at the upper edge.]

Frames shall be C-shaped channels. Side channels shall have legs turned as
required to suit the construction conditions.

Louvers shall be assembled by spot welding. Flanges shall be spot welded
to frame members not more than 6 inches 150 millimeter on center.

Horizontal and vertical mullions shall be provided where louver openings
exceed 72 inches 1800 millimeter in any direction. Mullions shall have
cover plates attached to the louver sections with screws not more than 12
inches 300 millimeter on center.

Sills shall be of the shape indicated and made of the same material and
thickness as the louvers.

**NOTE: Louvers requiring insect screens must be
indicated.**

Insect screens shall be provided for the exterior aluminum louvers
indicated. Insect screening shall be aluminum alloy, 18 by 16 regular mesh
per linear inch 25 linear millimeter size, aluminum alloy, conforming to
ASTM B 211 ASTM B 211M. Insect screening shall be mounted in extruded
aluminum rewirable frame. Screen units shall be mounted on the interior
side of the louvers.

**NOTE: Louvers requiring bird screens must be
indicated.**

Bird screens shall be provided for the exterior aluminum louvers indicated.
Bird screening shall be square mesh type, plain weave class, aluminum alloy
material, 2 by 2 inch 50 by 50 millimeter mesh size, 0.063-inch 1.6
millimeter wire diameter, conforming to FS RR-W-360, Square Mesh, Plain
Weave. Bird screening shall be mounted in extruded aluminum rewirable
frame. Screen units shall be mounted on the interior side of the louvers.

**NOTE: Finish must match adjacent aluminum work such
as aluminum doors and frames and aluminum windows.
When more than one finish is required, the location
of each finish must be specified.**

Finish of exposed-to-view surfaces shall be [mill finish.] [finished with
lacquer coating.] [frosted finish with Class II clear anodized coating.]
[frosted finish with Class I clear anodized coating.] [polished frosted

finish with Class II clear anodized coating.] [polished frosted finish with color anodized coating.] [polished frosted finish with integral color anodized coating.]

2.3.6 Extruded Aluminum Gravel Stop System

NOTE: Field formed aluminum sheet gravel stops are specified in Section 07600, "Flashing and Sheet Metal." Extruded aluminum gravel stop system must be detailed.

Extruded aluminum gravel stop system sections shall be of the shapes and dimensions indicated.

[Gravel stop system shall consist of gravel stop sections, welded, mitered inside and outside corner sections, exposed cover plates, concealed sheet metal flashing, and other components standard with the gravel stop system manufacturer as required to complete the installation.]

[Gravel stop system shall consist of gravel stop sections, fascia sections, soffit sections, welded mitered inside and outside corner sections, concealed cover plates, concealed sheet metal flashing, and other components standard with the gravel stop system manufacturer as required to complete the installation.]

Exposed gravel stop system components shall be made of aluminum-alloy extrusions having wall thickness not less than 0.05 inch 1.3 millimeter. Concealed components shall be made of aluminum-alloy sheets not less than 0.025-inch 0.64 millimeter thick.

NOTE: Finish must match adjacent aluminum work, such as aluminum doors and frames, aluminum windows, and aluminum siding. When more than one finish is required, the location of each finish must be specified.

Finish of exposed-to-view surfaces shall be [mill finish.] [frosted finish with lacquer coating.] [frosted finish with Class II clear anodized coating.] [frosted finish with Class I clear anodized coating.] [polished frosted finish with Class II clear anodized coating.] [polished frosted finish with Class I clear anodized coating.] [polished frosted finish with integral color anodized coating.]

2.4 FABRICATION IN GENERAL

Manufacturer's Standard Color Charts for Shop Paint and Finish Paint shall be approved by the Contracting Officer prior to work.

Installation Drawings for Ornamental Metal Items, Shop and Field Connections and Construction Details shall show location, dimensions, size, and weight or gage as applicable of each ornamental item; type and location of shop and field connections; and other pertinent construction and erection details. Drawings shall show location and details of anchorage devices embedded in cast-in-place concrete and masonry construction.

2.4.1 Workmanship

Metalwork shall be well formed to shape and size, with lines, angles, and curves true. Necessary rabbets, lugs, and brackets shall be provided so that the work can be assembled. Fasteners shall be concealed where practical.

Exterior ornamental metal items shall be designed to withstand expansion and contraction of the component parts at an ambient temperature of 100 degrees F 38 degrees C without causing harmful buckling, opening of joints, overstressing of fasteners, or other harmful effects.

Welded fabrication shall meet requirements as specified in AWS D1.2. Welds behind finished surfaces shall be made without distortion or discoloration of the exposed side. Welded joints shall be cleaned of flux and shall be dressed on exposed and contact surfaces.

Holes for fasteners shall be drilled or punched. Drilling and punching shall produce clean true lines and surfaces.

Joints shall be milled to a close fit. Corner joints shall be coped or mitered, well formed, and in true alignment. Joints exposed to weather shall be formed and fabricated to exclude water.

Castings shall be sound and free from warp or defects that impair their strength and appearance. Exposed surfaces shall have a smooth finish and sharp well-defined lines and arrises. Joints shall be milled to a close fit.

2.4.2 Holes for Other Work

Holes shall be provided where indicated for securing other work to metal work.

2.4.3 Protection of Aluminum from Dissimilar Materials

Aluminum surfaces that will come in contact with dissimilar metals, or masonry, concrete, or wood, shall be protected with epoxy polyamide conforming to SSPC-01, Chapter 16.2, and topcoated with aliphatic polyurethane conforming to ASTM G 104.

Aluminum surfaces to be painted shall be prepared by the acid pickling method conforming to ASTM D 1730, Type B, Method 2 or Method 3.

Paint shall be applied to dry, clean surfaces by brush or spraying to provide a minimum dry-film thickness of 1.5 mils (0.0015 inch) 0.038 millimeter.

2.4.4 Aluminum Finishes

Finish of exposed-to-view aluminum surfaces of architectural metal items shall conform to AA 45 and shall have the finish specified for each item and as follows:

Mill finish shall be the aluminum producer's as-fabricated finish, conforming to AA M10, as specified in AA 45.

Frosted finish with lacquer coating shall be a medium matte chemical

etch finish and a clear methacrylate lacquer coating, applied in two coats with interim drying, by brush, spraying, or other approved method to provide a continuous minimum dry film thickness of 0.6 mil (0.0006 inch) 0.015 millimeter. Lacquer shall be nonyellowing and shall conform to FS A-A-344. Finish shall conform to AA C22-R1X, as specified in AA 45.

Frosted finish with Class II clear anodized coating shall be a medium matte chemical etch finish and Architectural Class II (0.4- to 0.7-mil (0.010 to 0.018 millimeter thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA C22-A31, as specified in AA 45.

Frosted finish with Class I clear anodized coating shall be a medium matte chemical etch finish and Architectural Class I (0.7 mil (0.018 millimeter and greater thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA C22-A41, as specified in AA 45.

NOTE: The following polished, satin, and matte finishes generally are required for aluminum ornamental railings only.

Polished finish with Class II clear anodized coating shall be smooth specular buffed mechanical finish and Architectural Class II (0.4- to 0.7-mil (0.010 to 0.018 millimeter thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA M21-A31, as specified in AA 45.

Satin finish with Class II clear anodized coating shall be a medium satin directional textured mechanical finish and Architectural Class II (0.4- to 0.7-mil (0.010 to 0.018 millimeter thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA M32-A31, as specified in AA 45.

Matte finish with Class II clear anodized coating shall be a medium matte nondirectional textured mechanical finish and Architectural Class II (0.4- to 0.7-mil (0.010 to 0.018 millimeter thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA M42-A31, as specified in AA 45.

NOTE: The following polished-frosted finishes are the finishes specified for aluminum doors and frames and aluminum curtain wall systems and apply to exterior architectural metal items requiring a matching finish. Select the desired coating thickness.

Polished-frosted finish with Class II clear anodized coating shall be a smooth specular buffed mechanical finish, followed by a medium matte chemical etch finish and Architectural Class II (0.4- to 0.7-mil (0.010 to 0.018 millimeter thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA M21-C22-A31, as specified in AA 45.

Polished-frosted finish with Class I clear anodized coating shall be a smooth specular buffed mechanical finish, followed by a medium matte chemical etch finish and Architectural Class I (0.7-mil (0.018 millimeter and greater thickness) anodized coating producing natural aluminum color finish. Finish shall conform to AA M21-C22-A41, as specified in AA 45.

**NOTE: It is recommended that a sample of the
required color be on display where it may be seen by
bidders during the bidding period.**

Polished-frosted finish with integral-color anodized coating shall be a smooth specular buffed mechanical finish, followed by a nonetching inhibitive alkaline cleaning, medium matte, chemical etch finish and Architectural Class 1 (0.7-mil (0.018 millimeter and greater thickness) anodized coating producing dark bronze integral color finish. Finish shall conform to AA M21-C12-C22-A42, as specified in AA 45.

Finish color and appearance shall match that of the aluminum finish sample approved for each Architectural metal item within the aluminum producer's standard color range.

Preventative Maintenance and Inspection shall be in accordance with the aluminum producer's recommended Cleaning Materials and Application Methods including precautions in the use of cleaning materials that may be detrimental to the aluminum finish when improperly applied.

PART 3 EXECUTION

3.1 GENERAL PROVISIONS

Ornamental metal work shall be installed in accordance with the approved shop drawings and descriptive data for each ornamental metal item, as specified.

Ornamental metal items shall be securely fastened plumb and true to lines and levels.

3.2 ANCHORAGE DEVICES EMBEDDED IN OTHER CONSTRUCTION

Anchorage devices, such as concrete inserts, anchor bolts, and ornamental metal items having integral anchors that are to be embedded in cast-in-place concrete and masonry construction, shall be delivered to the project site in time to be installed before the start of cast-in-place concrete operations and masonry work. Setting drawings, templates, instructions, and directions for the installation of the anchorage items shall be provided.

3.3 FASTENING TO CONSTRUCTION-IN-PLACE

Anchorage devices and fasteners shall be provided where necessary for fastening ornamental metal items to construction-in-place. Fastening shall include threaded fasteners for concrete inserts embedded in cast-in-place concrete; masonry anchorage devices and threaded fasteners for solid masonry and concrete-in-place; toggle bolts for hollow masonry and stud partitions; through bolting for masonry and wood construction; lag bolts and wood screws for wood construction; and threaded fasteners for

structural steel. Fastening shall be provided as indicated and as specified. Fastening to wood plugs in masonry or concrete-in-place is not permitted.

3.4 CUTTING AND FITTING

Cutting, drilling, and fitting required shall be performed for the installation of ornamental metal work. Cutting, drilling, and fitting shall be executed carefully; when required, work shall be fitted in place before fastening.

3.5 SETTING MASONRY ANCHORAGE DEVICES

Masonry anchorage devices shall be set in masonry or concrete-in-place construction in accordance with the anchorage device manufacturer's printed instructions. Holes shall be of the recommended depth and diameter and shall be drilled to the size recommended by the manufacturer of the particular anchorage device used. Drilled holes shall be left rough, not reamed, and free of drill dust.

3.6 WELDING PROCEDURES

Procedures for welding, appearance, and quality of welds made, and the methods used in correcting welding work shall conform to AWS D1.2.

Exposed welds shall be ground smooth.

3.7 THREADED CONNECTIONS

Where exposed to view, bolt and screw heads shall be flat and countersunk, unless otherwise specified. Threaded connections shall be made up tightly so that the threads will be entirely concealed by fitting.

3.8 ALUMINUM ORNAMENTAL RAILINGS

Posts shall be spaced not more than 4 feet 1200 millimeter on center. End caps shall be provided for the open ends of tubular posts. Posts shall be plumb in each direction, and shall be secured to the building construction as follows:

Concrete anchorage at horizontal surfaces shall be by means of tubular sleeves set and anchored into the concrete. Sleeves shall be galvanized steel tubing having not less than 0.140-inch 3.6 millimeter wall thickness, not less than 6-inches 150 millimeter long, and with inside diameter not less than 1/2-inch 13 millimeter greater than the outside dimensions of the inserted post. Steel plate closure shall be provided and secured to the bottom of the sleeve and shall be of width and length not less than 1-inch 25 millimeter greater than the outside dimensions of the sleeve. After the posts have been inserted in the sleeves, the annular space between the post and sleeve shall be filled solid with either molten lead, sulfur, or quick-setting hydraulic cement. Anchorage joint shall be covered with an aluminum-alloy cover flange secured to the post.

Concrete anchorage at vertical surfaces shall be by means of wedge-type or slotted-type concrete inserts, and aluminum-alloy fascia brackets with corrosion-resistant steel threaded fasteners. Fasteners shall be concealed.

Steel anchorage at stair strings shall be by means of aluminum-alloy fascia flanges and corrosion-resistant steel threaded fasteners.

Horizontal rails shall be secured to posts by means of post brackets. Bracket projection between the post surface and the center of each rail shall be not less than 1-7/8 inches 48 millimeter. Brackets shall be secured to the posts with concealed fasteners. Joining of rails shall be done by splice connectors of such design that the rails can be drawn together at the splice with a hairline fit. Rail joining shall be made only at the center of the post brackets. Corner bends shall be provided at all locations where the horizontal rails change direction. End caps shall be provided at the ends of horizontal rails that are not attached to the building construction.

**NOTE: Clearance between handrails and walls
specified in the following paragraph meets the
requirements of paragraph 5-2.2.3 of NFPA 101.**

Handrails shall be secured to walls by means of wall brackets. Wall brackets shall provide a clearance of not less than 1-1/2 inches 38 millimeter between the handrail and the wall surface and shall be secured to the wall with a concealed fastener. Wall brackets shall be located not more than 18 inches 450 millimeter from handrail ends and not more than 54 inches 1350 millimeter on center. Wall return handrail sections shall be provided with the same projection as that specified for wall brackets at handrail ends. Joining of handrails and their location shall be the same as specified for horizontal rails. Wall brackets shall be secured to the building construction as follows:

Concrete and solid masonry anchorage shall be anchored by bolt anchor expansion shield and corrosion-resistant steel bolts.

Hollow masonry and stud partition anchorage shall be anchored by corrosion-resistant steel toggle bolts.

3.9 ALUMINUM PIPE RAILINGS

Posts shall be spaced not more than 6 feet 1800 millimeter on center. Posts shall be plumb in each direction. Posts and rail ends shall be secured to the building construction as follows:

Posts shall be anchored in concrete by pipe sleeves set and anchored into the concrete. Sleeves shall be galvanized, standard weight, steel pipe, not less than 6-inches 150 millimeter long with an inside diameter not less than 1/2-inch 13 millimeter greater than the outside diameter of the inserted pipe post. Steel plate closure shall be provided secured to the bottom of the sleeve; width and length shall be not less than 1-inch 25 millimeter greater than the outside diameter of the sleeve. After the posts have been inserted into the sleeves, the annular space between the post and sleeve shall be filled solid with molten lead, sulfur, or quick-setting hydraulic cement. Anchorage joint shall be covered with an aluminum-alloy cover flange secured to the post by the joining method specified.

Concrete and masonry anchorage for rail ends shall be aluminum-alloy round flanges secured to the rail ends by the joining method as specified and anchored into the wall construction with lead expansion

shields and corrosion-resistant steel threaded fasteners.

Steel anchorage for rail ends shall be aluminum-alloy round flanges secured to the rail ends by the joining method as specified and bolted to structural steel members with corrosion-resistant steel threaded fasteners.

Handrails shall be secured to walls by wall brackets and wall return fittings at handrail ends. Brackets shall be aluminum-alloy castings, with not less than 3-inch 75 millimeter projection between the finish wall surface to the center of the handrail, and with the wall plate portion of the bracket drilled to receive one 3/8-inch M10 bolt. Wall brackets shall be located not more than 54 inches 1350 millimeter on center. Wall return fittings shall be aluminum-alloy castings, the same type as the railing fittings used in the work, with the same projection as that specified for wall brackets. Wall brackets and wall return fittings shall be secured to building construction as follows:

Concrete and solid masonry shall be anchored by bolt anchor expansion shields and corrosion-resistant steel lag bolts.

Hollow masonry and stud partition shall be anchored by corrosion-resistant steel toggle bolts having square heads.

3.10 CLEANING

Before final acceptance, exposed-to-view aluminum surfaces shall be washed with clean water and soap and rinsed with clean water. Acid solutions, steel wool, or other harsh abrasives shall not be used. Stains that remain after washing shall be removed or the finish shall be restored in accordance with the aluminum producer's recommendations.

3.11 INSPECTION AND ACCEPTANCE PROVISIONS

3.11.1 Finished Ornamental Metal Work Requirements

Ornamental metal work will be rejected for any of the following deficiencies:

Finish of exposed-to-view aluminum surfaces having color and appearance that are outside the color and appearance range of the approved samples for aluminum finish

Installed ornamental metal items having stained, discolored, abraded, or otherwise damaged exposed-to-view aluminum surfaces that cannot be removed by cleaning or repairing

Installed ornamental metal items that do not match the approved sample

Aluminum surfaces in contact with dissimilar materials that are not protected as specified

3.11.2 Repair of Defective Work

Defective work shall be removed and replaced with ornamental metal materials that meet the requirements of this section.

3.12 MAINTENANCE INSTRUCTIONS

Contractor shall submit maintenance instructions as follows:

Aluminum producer's recommended cleaning materials and application methods including precautions in the use of cleaning materials that may be detrimental to the aluminum finish when improperly applied.

-- End of Section --